

SEQUENCE LISTING

<110> Dhugga, Kanwarpal S.
Wang, Haiyin

<120> Maize Cellulose Synthases and Uses
Thereof

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<151> 1998-08-17

<150> 09/371,383
<151> 1999-08-06

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<151> 2000-04-14

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<151> 2002-07-31

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Gly Val Ser Ala Thr Gly Asp Val Phe Val Ala Cys Asn Glu Cys Ala
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Phe Pro Val Cys Arg Pro Cys Tyr Glu Tyr Glu Arg Lys Glu Gly Asn
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Gln Cys Cys Pro Gln Cys Lys Thr Arg Tyr Lys Arg Gln Lys Gly Ser
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 His His Arg Ile Pro Arg Leu Thr Ser Gly Gln Gln Ile Ser Gly Glu
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 Ile Pro Asp Ala Ser Pro Asp Arg His Ser Ile Arg Ser Pro Thr Ser
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 Ser Tyr Val Asp Pro Ser Val Pro Val Pro Val Arg Ile Val Asp Pro
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 Ser Lys Asp Leu Asn Ser Tyr Gly Leu Asn Ser Val Asp Trp Lys Glu
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 Arg Val Glu Ser Trp Arg Val Lys Gln Asp Lys Asn Met Met Gln Val
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 Thr Asn Lys Tyr Pro Glu Ala Arg Gly Gly Asp Met Glu Gly Thr Gly
 225 230 235 240
 Ser Asn Gly Glu Asp Met Gln Met Val Asp Asp Ala Arg Leu Pro Leu
 245 250 255
 Ser Arg Ile Val Pro Ile Ser Ser Asn Gln Leu Asn Leu Tyr Arg Val
 260 265 270
 Val Ile Ile Leu Arg Leu Ile Ile Leu Cys Phe Phe Phe Gln Tyr Arg
 275 280 285
 Val Ser His Pro Val Arg Asp Ala Tyr Gly Leu Trp Leu Val Ser Val
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 Ile Cys Glu Val Trp Phe Ala Leu Ser Trp Leu Leu Asp Gln Phe Pro
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 Lys Trp Tyr Pro Ile Asn Arg Glu Thr Tyr Leu Asp Arg Leu Ala Leu
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 Arg Tyr Asp Arg Glu Gly Glu Pro Ser Gln Leu Ala Pro Ile Asp Val
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 405 410 415
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 Arg Ala Met Lys Arg Glu Tyr Glu Glu Phe Lys Val Arg Ile Asn Ala
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 Asp Gly Thr Ala Trp Pro Gly Asn Asn Pro Arg Asp His Pro Gly Met
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 Glu Leu Pro Arg Leu Val Tyr Val Ser Arg Glu Lys Arg Pro Gly Phe
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   35          40          45
Ser Val Ile Cys Glu Val Trp Phe Ala Leu Ser Trp Leu Leu Asp Gln
   50          55          60
Phe Pro Lys Trp Tyr Pro Ile Asn Arg Glu Thr Tyr Leu Asp Arg Leu
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Ala Leu Arg Tyr Asp Arg Glu Gly Glu Pro Ser Gln Leu Ala Pro Ile
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Thr Gly Asn Thr Val Leu Ser Ile Leu Ala Val Asp Tyr Pro Val Asp
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Lys Val Ser Cys Tyr Val Ser Asp Asp Gly Ser Ala Met Leu Thr Phe
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Glu Ala Leu Ser Glu Thr Ala Glu Phe Ala Arg Lys Trp Val Pro Phe
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Cys Lys Lys His Asn Ile Glu Pro Arg Ala Pro Glu Phe Tyr Phe Ala
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Arg Lys Ile Asp Tyr Leu Lys Asp Lys Ile Gln Pro Ser Phe Val Lys
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 Met Ala Asp Gly Thr Pro Trp Pro Gly Asn Asn Pro Arg Asp His Pro
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 245 250 255
 Gly Asn Glu Leu Pro Arg Leu Val Tyr Val Ser Arg Glu Lys Arg Pro
 260 265 270
 Gly Phe Gln His His Lys Ala Gly Ala Met Asn Ala Leu Ile Arg
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 Val Ser Ala Val Leu Thr Asn Gly Ala Tyr Leu Leu Asn Val Asp Cys
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 Gly Tyr Asp Pro Val Leu Thr Glu Ala Asp Leu Glu Pro Asn Ile Ile
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 Tyr Cys Val Leu Pro Ala Ile Cys Leu Leu Thr Asn Lys Phe Ile Ile
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 Ser Ala His Leu Phe Ala Val Phe Gln Gly Leu Leu Lys Val Leu Ala
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 Gly Asp Phe Ala Glu Leu Tyr Val Phe Lys Trp Thr Thr Leu Leu Ile
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 Cys Tyr Glu Tyr Glu Arg Lys Asp Gly Thr Gln Ala Cys Pro Gln Cys
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 Lys Thr Lys Tyr Lys Arg His Lys Gly Ser Pro Ala Ile Arg Gly Glu
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 Glu Gly Asp Asp Thr Asp Ala Asp Ser Asp Phe Asn Tyr Leu Ala Ser
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 Gly Asn Glu Asp Gln Lys Gln Ile Ala Asp Arg Met Arg Ser Trp
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 Arg Met Asn Val Gly Gly Ser Gly Asp Val Gly Arg Pro Lys Tyr Asp
 115 120 125
 Ser Gly Glu Ile Gly Leu Thr Lys Tyr Asp Ser Gly Glu Ile Pro Arg
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 Gly Tyr Ile Pro Ser Val Thr Asn Ser Gln Ile Ser Gly Glu Ile Pro
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 Gly Ala Ser Pro Asp His His Met Met Ser Pro Thr Gly Asn Ile Gly
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 Lys Arg Ala Pro Phe Pro Tyr Val Asn His Ser Pro Asn Pro Ser Arg
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 Gly Trp Lys Met Lys Gln Asp Lys Gly Thr Ile Pro Met Thr Asn Gly
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 Ser Thr Asp Tyr Asn Met Glu Asp Ala Leu Leu Asn Asp Glu Thr Arg
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 Gln Pro Leu Ser Arg Lys Val Pro Leu Pro Ser Ser Arg Ile Asn Pro
 260 265 270
 Tyr Arg Met Val Ile Val Leu Arg Leu Ile Val Leu Ser Ile Phe Leu
 275 280 285
 His Tyr Arg Ile Thr Asn Pro Val Arg Asn Ala Tyr Pro Leu Trp Leu
 290 295 300
 Leu Ser Val Ile Cys Glu Ile Trp Phe Ala Leu Ser Trp Ile Leu Asp
 305 310 315 320
 Gln Phe Pro Lys Trp Phe Pro Ile Asn Arg Glu Thr Tyr Leu Asp Arg
 325 330 335
 Leu Ala Leu Arg Tyr Asp Arg Glu Gly Glu Pro Ser Gln Leu Ala Ala
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 Val Asp Ile Phe Val Ser Thr Val Asp Pro Met Lys Glu Pro Pro Leu
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 Val Thr Ala Asn Thr Val Leu Ser Ile Leu Ala Val Asp Tyr Pro Val
 370 375 380
 Asp Lys Val Ser Cys Tyr Val Ser Asp Asp Gly Ala Ala Met Leu Thr
 385 390 395 400
 Phe Asp Ala Leu Ala Glu Thr Ser Glu Phe Ala Arg Lys Trp Val Pro
 405 410 415
 Phe Val Lys Lys Tyr Asn Ile Glu Pro Arg Ala Pro Glu Trp Tyr Phe
 420 425 430
 Ser Gln Lys Ile Asp Tyr Leu Lys Asp Lys Val His Pro Ser Phe Val
 435 440 445
 Lys Asp Arg Arg Ala Met Lys Arg Glu Tyr Glu Glu Phe Lys Val Arg
 450 455 460

Val Asn Gly Leu Val Ala Lys Ala Gln Lys Val Pro Glu Glu Gly Trp
 465 470 475 480
 Ile Met Gln Asp Gly Thr Pro Trp Pro Gly Asn Asn Thr Arg Asp His
 485 490 495
 Pro Gly Met Ile Gln Val Phe Leu Gly His Ser Gly Gly Leu Asp Thr
 500 505 510
 Glu Gly Asn Glu Leu Pro Arg Leu Val Tyr Val Ser Arg Glu Lys Arg
 515 520 525
 Pro Gly Phe Gln His His Lys Lys Ala Gly Ala Met Asn Ala Leu Val
 530 535 540
 Arg Val Ser Ala Val Leu Thr Asn Gly Gln Tyr Met Leu Asn Leu Asp
 545 550 555 560
 Cys Asp His Tyr Ile Asn Asn Ser Lys Ala Leu Arg Glu Ala Met Cys
 565 570 575
 Phe Leu Met Asp Pro Asn Leu Gly Arg Ser Val Cys Tyr Val Gln Phe
 580 585 590
 Pro Gln Arg Phe Asp Gly Ile Asp Arg Asn Asp Arg Tyr Ala Asn Arg
 595 600 605
 Asn Thr Val Phe Phe Asp Ile Asn Leu Arg Gly Leu Asp Gly Ile Gln
 610 615 620
 Gly Pro Val Tyr Val Gly Thr Gly Cys Val Phe Asn Arg Thr Ala Leu
 625 630 635 640
 Tyr Gly Tyr Glu Pro Pro Ile Lys Gln Lys Lys Gly Phe Leu Ser
 645 650 655
 Ser Leu Cys Gly Gly Arg Lys Lys Ala Ser Lys Ser Lys Lys Gly Ser
 660 665 670
 Asp Lys Lys Ser Gln Lys His Val Asp Ser Ser Val Pro Val Phe
 675 680 685
 Asn Leu Glu Asp Ile Glu Glu Gly Val Glu Gly Ala Gly Phe Asp Asp
 690 695 700
 Glu Lys Ser Leu Leu Met Ser Gln Met Ser Leu Glu Lys Arg Phe Gly
 705 710 715 720
 Gln Ser Ala Ala Phe Val Ala Ser Thr Leu Met Glu Tyr Gly Gly Val
 725 730 735
 Pro Gln Ser Ala Thr Pro Glu Ser Leu Leu Lys Glu Ala Ile His Val
 740 745 750
 Ile Ser Cys Gly Tyr Glu Asp Lys Thr Glu Trp Gly Thr Glu Ile Gly
 755 760 765
 Trp Ile Tyr Gly Ser Val Thr Glu Asp Ile Leu Thr Gly Phe Lys Met
 770 775 780
 His Ala Arg Gly Trp Arg Ser Ile Tyr Cys Met Pro Lys Arg Pro Ala
 785 790 795 800
 Phe Lys Gly Ser Ala Pro Ile Asn Leu Ser Asp Arg Leu Asn Gln Val
 805 810 815
 Leu Arg Trp Ala Leu Gly Ser Val Glu Ile Leu Phe Ser Arg His Cys
 820 825 830
 Pro Leu Trp Tyr Gly Tyr Gly Arg Leu Lys Phe Leu Glu Arg Phe
 835 840 845
 Ala Tyr Ile Asn Thr Thr Ile Tyr Pro Leu Thr Ser Ile Pro Leu Leu
 850 855 860
 Ile Tyr Cys Ile Leu Pro Ala Ile Cys Leu Leu Thr Gly Lys Phe Ile
 865 870 875 880
 Ile Pro Glu Ile Ser Asn Phe Ala Ser Ile Trp Phe Ile Ser Leu Phe
 885 890 895
 Ile Ser Ile Phe Ala Thr Gly Ile Leu Glu Met Arg Trp Ser Gly Val
 900 905 910
 Gly Ile Asp Glu Trp Trp Arg Asn Glu Gln Phe Trp Val Ile Gly Gly
 915 920 925

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<212> DNA
<213> Zea mays

<400> 11
atqqaqqqccq acqcqqqacqq cqtqa

25

<210> 12
<211> 25
<212> DNA
<213> Zea mays

<400> 12
ctagcagttg atgccacacq tctgg

25

<210> 13
<211> 3704
<212> DNA
<213> Zea mays

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cgccggcagc cgggggggaa acggcaggaa tggcggtagt cgccggggggt ccgggttgg 240
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ccggacactt ttccggccgt ggacgcgtt cgggtttttccgt tggtggccgc ctgtacgtac 420
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aactctatgc cagatccggc gagatggcc ttggatcttc ctggatcatc tgatgtcc 780
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<210> 14

<211> 1076

<212> PRT

<213> Zea mays

<400> 14

Met Asp Gly Gly Asp Ala Thr Asn Ser Gly Lys His Val Ala Gly Gln

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Val Cys Gln Ile Cys Gly Asp Gly Val Gly Thr Ala Ala Asp Gly Asp

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Leu Phe Thr Ala Cys Asp Val Cys Gly Phe Pro Val Cys Arg Pro Cys			
35	40	45	
Tyr Glu Tyr Glu Arg Lys Asp Gly Thr Gln Ala Cys Pro Gln Cys Lys			
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Thr Lys Tyr Lys Arg His Lys Gly Ser Pro Pro Val His Gly Glu Glu			
65	70	75	80
Asn Glu Asp Val Asp Ala Asp Asp Val Ser Asp Tyr Asn Tyr Gln Ala			
85	90	95	
Ser Gly Asn Gln Asp Gln Lys Ile Ala Glu Arg Met Leu Thr			
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Trp Arg Thr Asn Ser Arg Gly Ser Asp Ile Gly Leu Ala Lys Tyr Asp			
115	120	125	
Ser Gly Glu Ile Gly His Gly Lys Tyr Asp Ser Gly Glu Ile Pro Arg			
130	135	140	
Gly Tyr Ile Pro Ser Leu Thr His Ser Gln Ile Ser Gly Glu Ile Pro			
145	150	155	160
Gly Ala Ser Pro Asp His Met Met Ser Pro Val Gly Asn Ile Gly Arg			
165	170	175	
Arg Gly His Gln Phe Pro Tyr Val Asn His Ser Pro Asn Pro Ser Arg			
180	185	190	
Glu Phe Ser Gly Ser Leu Gly Asn Val Ala Trp Lys Glu Arg Val Asp			
195	200	205	
Gly Trp Lys Met Lys Asp Lys Gly Ala Ile Pro Met Thr Asn Gly Thr			
210	215	220	
Ser Ile Ala Pro Ser Glu Gly Arg Gly Val Ala Asp Ile Asp Ala Ser			
225	230	235	240
Thr Asp Tyr Asn Met Glu Asp Ala Leu Leu Asn Asp Glu Thr Arg Gln			
245	250	255	
Pro Leu Ser Arg Lys Val Pro Ile Pro Ser Ser Arg Ile Asn Pro Tyr			
260	265	270	
Arg Met Val Ile Val Leu Arg Leu Ala Val Leu Cys Ile Phe Leu Arg			
275	280	285	
Tyr Arg Ile Thr His Pro Val Asn Asn Ala Tyr Pro Leu Trp Leu Leu			
290	295	300	
Ser Val Ile Cys Glu Ile Trp Phe Ala Leu Ser Trp Ile Leu Asp Gln			
305	310	315	320
Phe Pro Lys Trp Ser Pro Ile Asn Arg Glu Thr Tyr Leu Asp Arg Leu			
325	330	335	
Ala Leu Arg Tyr Asp Arg Glu Gly Glu Pro Ser Gln Leu Ala Pro Val			
340	345	350	
Asp Ile Phe Val Ser Thr Val Asp Pro Met Lys Glu Pro Pro Leu Val			
355	360	365	
Thr Ala Asn Thr Val Leu Ser Ile Leu Ala Val Asp Tyr Pro Val Asp			
370	375	380	
Lys Val Ser Cys Tyr Val Ser Asp Asp Gly Ala Ala Met Leu Thr Phe			
385	390	395	400
Asp Ala Leu Ser Glu Thr Ser Glu Phe Ala Arg Lys Trp Val Pro Phe			
405	410	415	
Cys Lys Tyr Asn Ile Glu Pro Arg Ala Pro Glu Trp Tyr Phe Ala			
420	425	430	
Gln Lys Ile Asp Tyr Leu Lys Asp Lys Val Gln Thr Ser Phe Val Lys			
435	440	445	
Glu Arg Arg Ala Met Lys Arg Glu Tyr Glu Glu Phe Lys Val Arg Ile			
450	455	460	
Asn Gln Leu Val Ala Lys Ala Gln Lys Val Pro Glu Glu Gly Trp Ile			
465	470	475	480
Met Gln Asp Gly Thr Pro Trp Pro Gly Asn Asn Thr Arg Asp His Pro			

	485	490	495
Gly Met Ile Gln Val Phe Leu Gly His Ser Gly Gly Leu Asp Val Glu	500	505	510
Gly Asn Glu Leu Pro Arg Leu Val Tyr Val Ser Arg Glu Lys Arg Pro	515	520	525
Gly Phe Gln His His Lys Lys Ala Gly Ala Met Asn Ala Leu Val Arg	530	535	540
Val Ser Ala Val Leu Thr Asn Gly Gln Tyr Met Leu Asn Leu Asp Cys	545	550	555
Asp His Tyr Ile Asn Asn Ser Lys Ala Leu Arg Glu Ala Met Cys Phe	565	570	575
Leu Met Asp Pro Asn Leu Gly Arg Asn Val Cys Tyr Val Gln Phe Pro	580	585	590
Gln Arg Phe Asp Gly Ile Asp Arg Asn Asp Arg Tyr Ala Asn Arg Asn	595	600	605
Thr Val Phe Phe Asp Ile Asn Leu Arg Gly Leu Asp Gly Ile Gln Gly	610	615	620
Pro Val Tyr Val Gly Thr Gly Cys Val Phe Asn Arg Thr Ala Leu Tyr	625	630	635
Gly Tyr Glu Pro Pro Val Lys Lys Lys Pro Gly Phe Phe Ser Ser	645	650	655
Leu Cys Gly Gly Arg Lys Lys Thr Ser Lys Ser Lys Ser Ser Glu	660	665	670
Lys Lys Lys Ser His Arg His Ala Asp Ser Ser Val Pro Val Phe Asn	675	680	685
Leu Glu Asp Ile Glu Glu Gly Ile Glu Gly Ser Gln Phe Asp Asp Glu	690	695	700
Lys Ser Leu Ile Met Ser Gln Met Ser Leu Glu Lys Arg Phe Gly Gln	705	710	715
Ser Ser Val Phe Val Ala Ser Thr Leu Met Glu Tyr Gly Gly Val Pro	725	730	735
Gln Ser Ala Thr Pro Glu Ser Leu Leu Lys Glu Ala Ile His Val Ile	740	745	750
Ser Cys Gly Tyr Glu Asp Lys Thr Asp Trp Gly Thr Glu Ile Gly Trp	755	760	765
Ile Tyr Gly Ser Val Thr Glu Asp Ile Leu Thr Gly Phe Lys Met His	770	775	780
Ala Arg Gly Trp Arg Ser Ile Tyr Cys Met Pro Lys Arg Pro Ala Phe	785	790	795
Lys Gly Ser Ala Pro Ile Asn Leu Ser Asp Arg Leu Asn Gln Val Leu	805	810	815
Arg Trp Ala Leu Gly Ser Ile Glu Ile Leu Phe Ser Arg His Cys Pro	820	825	830
Ile Trp Tyr Gly Tyr Gly Arg Leu Lys Phe Leu Glu Arg Phe Ala	835	840	845
Tyr Ile Asn Thr Thr Ile Tyr Pro Leu Thr Ser Ile Pro Leu Leu Leu	850	855	860
Tyr Cys Ile Leu Pro Ala Val Cys Leu Leu Thr Gly Lys Phe Ile Ile	865	870	875
Pro Lys Ile Ser Asn Leu Glu Ser Val Trp Phe Ile Ser Leu Phe Ile	885	890	895
Ser Ile Phe Ala Thr Gly Ile Leu Glu Met Arg Trp Ser Gly Val Gly	900	905	910
Ile Asp Glu Trp Trp Arg Asn Glu Gln Phe Trp Val Ile Gly Gly Ile	915	920	925
Ser Ala His Leu Phe Ala Val Phe Gln Gly Leu Leu Lys Val Leu Ala	930	935	940
Gly Ile Asp Thr Ser Phe Thr Val Thr Ser Lys Ala Thr Asp Glu Glu			

945	950	955	960
Gly Asp Phe Ala Glu Leu Tyr Met Phe Lys Trp Thr Thr Leu Leu Ile			
965	970	975	
Pro Pro Thr Thr Ile Leu Ile Ile Asn Leu Val Gly Val Val Ala Gly			
980	985	990	
Ile Ser Tyr Ala Ile Asn Ser Gly Tyr Gln Ser Trp Gly Pro Leu Phe			
995	1000	1005	
Gly Lys Leu Phe Phe Ala Phe Trp Val Ile Val His Leu Tyr Pro Phe			
1010	1015	1020	
Leu Lys Gly Leu Met Gly Lys Gln Asn Arg Thr Pro Thr Ile Val Val			
1025	1030	1035	1040
Val Trp Ala Ile Leu Leu Ala Ser Ile Phe Ser Leu Met Trp Val Arg			
1045	1050	1055	
Ile Asp Pro Phe Thr Thr Arg Val Thr Gly Pro Asp Ile Ala Lys Cys			
1060	1065	1070	
Gly Ile Asn Cys			
1075			

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<212> DNA
<213> Zea mays

<400> 15
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25

<210> 16
<211> 25
<212> DNA
<213> Zea mays

<400> 16
ctagcagttg atgccacatt tcgcg

25

<210> 17
<211> 3813
<212> DNA
<213> Zea mays

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ccagaggagg ggaggactac gtgcatttcg ctgtgcgcgc gcccgcgggt tcgtgcgcga 180
gcgatgtccg gccccgggggg gccccggggcc tgatgtggag gctagcgcgg ggctgtgtgc 240
cggtctcgat aaccggaaacg agctgttgtt gatccgcgc gaccgcgagt cggagccgc 300
ggccggccggc gccccggccgc gggccggaggc gccgtgcgcg atatgcggcg acggaggcgg 360
gttggcccttc gacggggagc ctttcgtggc gtcaacagc tgccgccttc cggctctgcgc 420
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cgatgcggcgg tccatgtcta gggcgcgat gagctacggc cggcgccgc acgcgcaccc 660
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gaggatccac ccgttccttc tgcacatcc caacccctca gtgcacaaccg gatccatgg 840
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<210> 18

<211> 1094

<212> PRT

<400> 18

Met Glu Al

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Leu Val Val Ile Arg Arg Asp Arg Glu Ser Gly Ala Ala Gly Gly Gly

17

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 50 55 60
 Phe Pro Val Cys Arg Ala Cys Tyr Glu Tyr Glu Arg Arg Glu Gly Ser
 65 70 75 80
 Gln Ala Cys Pro Gln Cys Arg Thr Arg Tyr Lys Arg Leu Lys Gly Cys
 85 90 95
 Pro Arg Val Ala Gly Asp Glu Glu Asp Gly Val Asp Asp Leu Glu
 100 105 110
 Gly Glu Phe Gly Leu Gln Asp Gly Ala Ala His Glu Asp Asp Pro Gln
 115 120 125
 Tyr Val Ala Glu Ser Met Leu Arg Ala Gln Met Ser Tyr Gly Arg Gly
 130 135 140
 Gly Asp Ala His Pro Gly Phe Ser Pro Val Pro Asn Val Pro Leu Leu
 145 150 155 160
 Thr Asn Gly Gln Met Val Asp Asp Ile Pro Pro Glu Gln His Ala Leu
 165 170 175
 Val Pro Ser Tyr Met Ser Gly Gly Gly Gly Lys Arg Ile His
 180 185 190
 Pro Leu Pro Phe Ala Asp Pro Asn Leu Pro Val Gln Pro Arg Ser Met
 195 200 205
 Asp Pro Ser Lys Asp Leu Ala Ala Tyr Gly Tyr Gly Ser Val Ala Trp
 210 215 220
 Lys Glu Arg Met Glu Gly Trp Lys Gln Lys Gln Glu Arg Leu Gln His
 225 230 235 240
 Val Arg Ser Glu Gly Gly Asp Trp Asp Gly Asp Asp Ala Asp Leu
 245 250 255
 Pro Leu Met Asp Glu Ala Arg Gln Pro Leu Ser Arg Lys Val Pro Ile
 260 265 270
 Ser Ser Ser Arg Ile Asn Pro Tyr Arg Met Ile Ile Val Ile Arg Leu
 275 280 285
 Val Val Leu Gly Phe Phe His Tyr Arg Val Met His Pro Ala Lys
 290 295 300
 Asp Ala Phe Ala Leu Trp Leu Ile Ser Val Ile Cys Glu Ile Trp Phe
 305 310 315 320
 Ala Met Ser Trp Ile Leu Asp Gln Phe Pro Lys Trp Leu Pro Ile Glu
 325 330 335
 Arg Glu Thr Tyr Leu Asp Arg Leu Ser Leu Arg Phe Asp Lys Glu Gly
 340 345 350
 Gln Pro Ser Gln Leu Ala Pro Ile Asp Phe Phe Val Ser Thr Val Asp
 355 360 365
 Pro Thr Lys Glu Pro Pro Leu Val Thr Ala Asn Thr Val Leu Ser Ile
 370 375 380
 Leu Ser Val Asp Tyr Pro Val Glu Lys Val Ser Cys Tyr Val Ser Asp
 385 390 395 400
 Asp Gly Ala Ala Met Leu Thr Phe Glu Ala Leu Ser Glu Thr Ser Glu
 405 410 415
 Phe Ala Lys Lys Trp Val Pro Phe Ser Lys Lys Phe Asn Ile Glu Pro
 420 425 430
 Arg Ala Pro Glu Trp Tyr Phe Gln Gln Lys Ile Asp Tyr Leu Lys Asp
 435 440 445
 Lys Val Ala Ala Ser Phe Val Arg Glu Arg Arg Ala Met Lys Arg Glu
 450 455 460
 Tyr Glu Glu Phe Lys Val Arg Ile Asn Ala Leu Val Ala Lys Ala Gln
 465 470 475 480
 Lys Val Pro Glu Glu Gly Trp Thr Met Gln Asp Gly Ser Pro Trp Pro
 485 490 495

Gly Asn Asn Val Arg Asp His Pro Gly Met Ile Gln Val Phe Leu Gly
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 Gln Ser Gly Gly Arg Asp Val Glu Gly Asn Glu Leu Pro Arg Leu Val
 515 520 525
 Tyr Val Ser Arg Glu Lys Arg Pro Gly Tyr Asn His His Lys Lys Ala
 530 535 540
 Gly Ala Met Asn Ala Leu Val Arg Val Ser Ala Val Leu Ser Asn Ala
 545 550 555 560
 Ala Tyr Leu Leu Asn Leu Asp Cys Asp His Tyr Ile Asn Asn Ser Lys
 565 570 575
 Ala Ile Lys Glu Ala Met Cys Phe Met Met Asp Pro Leu Val Gly Lys
 580 585 590
 Lys Val Cys Tyr Val Gln Phe Pro Gln Arg Phe Asp Gly Ile Asp Lys
 595 600 605
 Asn Asp Arg Tyr Ala Asn Arg Asn Val Val Phe Phe Asp Ile Asn Met
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 Lys Gly Leu Asp Gly Ile Gln Gly Pro Ile Tyr Val Gly Thr Gly Cys
 625 630 635 640
 Val Phe Arg Arg Gln Ala Leu Tyr Gly Tyr Asp Ala Pro Lys Thr Lys
 645 650 655
 Lys Pro Pro Ser Arg Thr Cys Asn Cys Trp Pro Lys Trp Cys Leu Ser
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 Cys Cys Cys Ser Arg Asn Lys Asn Lys Lys Lys Thr Thr Lys Pro Lys
 675 680 685
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 Pro Ala Tyr Ala Leu Gly Glu Ile Asp Glu Gly Ala Pro Gly Ala Asp
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 Gly Gln Ser Val Phe Val Ala Ser Thr Leu Leu Glu Asn Gly Gly
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 Val Ile Ser Cys Gly Tyr Glu Asp Lys Thr Asp Trp Gly Lys Glu Ile
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 Gly Trp Ile Tyr Gly Ser Ile Thr Glu Asp Ile Leu Thr Gly Phe Lys
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 Met His Cys His Gly Trp Arg Ser Ile Tyr Cys Ile Pro Lys Arg Pro
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 Val Leu Arg Trp Ala Leu Gly Ser Val Glu Ile Phe Phe Ser Lys His
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 Cys Pro Leu Trp Tyr Gly Tyr Gly Gly Leu Lys Phe Leu Glu Arg
 850 855 860
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 915 920 925
 Val Ala Ile Asp Asp Trp Trp Arg Asn Glu Gln Phe Trp Val Ile Gly
 930 935 940
 Gly Val Ser Ala His Leu Phe Ala Val Phe Gln Gly Leu Leu Lys Val
 945 950 955 960

Phe Ala Gly Ile Asp Thr Ser Phe Thr Val Thr Ser Lys Ala Gly Asp
 965 970 975
 Asp Glu Glu Phe Ser Glu Leu Tyr Thr Phe Lys Trp Thr Thr Leu Leu
 980 985 990
 Ile Pro Pro Thr Thr Leu Leu Leu Asn Phe Ile Gly Val Val Ala
 995 1000 1005
 Gly Ile Ser Asn Ala Ile Asn Asn Gly Tyr Glu Ser Trp Gly Pro Leu
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 Phe Gly Lys Leu Phe Phe Ala Phe Trp Val Ile Val His Leu Tyr Pro
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 Phe Leu Lys Gly Leu Val Gly Arg Gln Asn Arg Thr Pro Thr Ile Val
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 Cys Gly Leu Asp Cys Asn
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 <212> DNA
 <213> Zea mays

<400> 19
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25

<210> 20
 <211> 25
 <212> DNA
 <213> Zea mays

<400> 20
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25

<210> 21
 <211> 3799
 <212> DNA
 <213> Zea mays

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 <223> n = A,T,C or G

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20

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 Cys Tyr Glu Tyr Glu Arg Lys Asp Gly Thr Gln Ala Cys Pro Gln Cys
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 Lys Asn Lys Tyr Lys Arg His Lys Gly Ser Pro Ala Ile Arg Gly Glu
 65 70 75 80
 Glu Gly Asp Asp Thr Asp Ala Asp Asp Ala Ser Asp Phe Asn Tyr Pro
 85 90 95
 Ala Ser Gly Asn Asp Asp Gln Lys Gln Lys Ile Ala Asp Arg Met Arg
 100 105 110
 Ser Trp Arg Met Asn Ala Gly Gly Ser Gly Asp Val Gly Arg Pro Lys
 115 120 125
 Tyr Asp Ser Gly Glu Ile Gly Leu Thr Lys Tyr Asp Ser Gly Glu Ile
 130 135 140
 Pro Arg Gly Tyr Ile Pro Ser Val Thr Asn Ser Gln Ile Ser Gly Glu
 145 150 155 160
 Ile Pro Gly Ala Ser Pro Asp His His Met Met Ser Pro Thr Gly Asn
 165 170 175
 Ile Gly Arg Arg Ala Pro Phe Pro Tyr Met Asn His Ser Ser Asn Pro
 180 185 190
 Ser Arg Glu Phe Ser Gly Ser Val Gly Asn Val Ala Trp Lys Glu Arg
 195 200 205
 Val Asp Gly Trp Lys Met Lys Gln Asp Lys Gly Thr Ile Pro Met Thr
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 Asn Gly Thr Ser Ile Ala Pro Ser Glu Gly Arg Gly Val Gly Asp Ile
 225 230 235 240
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 Thr Arg Gln Pro Leu Ser Arg Lys Val Pro Leu Pro Ser Ser Arg Ile
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 Pro Leu Val Thr Ala Asn Thr Val Leu Ser Ile Leu Ala Val Asp Tyr
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 Tyr Phe Ser Gln Lys Ile Asp Tyr Leu Lys Asp Lys Val His Pro Ser
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 Phe Gly Gln Ser Ala Ala Phe Val Ala Ser Thr Leu Met Glu Tyr Gly
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 Gly Val Pro Gln Ser Ala Thr Pro Glu Ser Leu Leu Lys Glu Ala Ile
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 Ile Gly Trp Ile Tyr Gly Ser Val Thr Glu Asp Ile Leu Thr Gly Phe
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24

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<212> PRT

<213> Zea mays

<400> 26

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Gln Cys Cys Pro Gln Cys Asn Thr Arg Tyr Lys Arg Gln Lys Gly Cys		80
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Pro Arg Val Glu Gly Asp Glu Glu Gly Pro Glu Met Asp Asp Phe		
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Glu Asp Glu Phe Pro Ala Lys Ser Pro Lys Lys Pro His Glu Pro Val		
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Ala Phe Asp Val Tyr Ser Glu Asn Gly Glu His Pro Ala Gln Lys Trp		
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Arg Thr Gly Gly Gln Thr Leu Ser Ser Phe Thr Gly Ser Val Ala Gly		
145	150	155
Lys Asp Leu Glu Ala Glu Arg Glu Met Glu Gly Ser Met Glu Trp Lys		160
165	170	175
Asp Arg Ile Asp Lys Trp Lys Thr Lys Gln Glu Lys Arg Gly Lys Leu		
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Asn His Asp Asp Ser Asp Asp Asp Asp Lys Asn Glu Asp Glu Tyr		
195	200	205
Met Leu Leu Ala Glu Ala Arg Gln Pro Leu Trp Arg Lys Val Pro Ile		
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Pro Ser Ser Met Ile Asn Pro Tyr Arg Ile Val Ile Val Leu Arg Leu		
225	230	235
Val Val Leu Cys Phe Phe Leu Lys Phe Arg Ile Thr Thr Pro Ala Thr		
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260	265	270
Ala Phe Ser Trp Ile Leu Asp Gln Leu Pro Lys Trp Ala Pro Val Thr		
275	280	285
Arg Glu Thr Tyr Leu Asp Arg Leu Ala Leu Arg Tyr Asp Arg Glu Gly		
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Pro Leu Lys Glu Pro Pro Ile Ile Thr Ala Asn Thr Val Leu Ser Ile		
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Leu Ala Val Asp Tyr Pro Val Asp Arg Val Ser Cys Tyr Val Ser Asp		
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Phe Ala Arg Arg Trp Val Pro Phe Cys Lys Lys Phe Ala Val Glu Pro		
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Arg Ala Pro Glu Phe Tyr Phe Ser Gln Lys Ile Asp Tyr Leu Lys Asp		
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Lys Val Gln Pro Thr Phe Val Lys Glu Arg Arg Ala Met Lys Arg Glu		
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Tyr Glu Glu Phe Lys Val Arg Ile Asn Ala Leu Val Ala Lys Ala Gln		
420	425	430
Lys Lys Pro Glu Glu Gly Trp Val Met Gln Asp Gly Thr Pro Trp Pro		
435	440	445
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450	455	460
Asn Gln Gly Ala Leu Asp Val Glu Gly His Glu Leu Pro Arg Leu Val		
465	470	475
Tyr Val Ser Arg Glu Lys Arg Pro Gly Tyr Asn His His Lys Lys Ala		480
485	490	495
Gly Ala Met Asn Ala Leu Val Arg Val Ser Ala Val Leu Thr Asn Ala		

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Ala Val Arg Glu Ala Met Cys Phe Leu Met Asp Pro Gln Leu Gly Lys		
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Lys Leu Cys Tyr Val Gln Phe Pro Gln Arg Phe Asp Gly Ile Asp Arg		
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His Asp Arg Tyr Ala Asn Arg Asn Val Val Phe Phe Asp Ile Asn Met		
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Lys Gly Leu Asp Gly Ile Gln Gly Pro Val Tyr Val Gly Thr Gly Cys		
580	585	590
Val Phe Asn Arg Gln Ala Leu Tyr Gly Tyr Asp Pro Pro Arg Pro Glu		
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Lys Arg Pro Lys Met Thr Cys Asp Cys Trp Pro Ser Trp Cys Cys Cys		
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625	630	635
Lys Gly Asp Gly Gly Glu Glu Pro Arg Arg Gly Leu Leu Gly Phe Tyr		
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Arg Lys Arg Ser Lys Lys Asp Lys Leu Gly Gly Ser Val Ala Gly		
660	665	670
Ser Lys Lys Gly Gly Lys Leu Tyr Lys Lys His Gln Arg Ala Phe Glu		
675	680	685
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690	695	700
Ser Ser Leu Met Ser Gln Lys Ser Phe Glu Lys Arg Phe Gly Gln Ser		
705	710	715
Pro Val Phe Ile Ala Ser Thr Leu Val Glu Asp Gly Gly Leu Pro Gln		
725	730	735
Gly Ala Ala Ala Asp Pro Ala Ala Leu Ile Lys Glu Ala Ile His Val		
740	745	750
Ile Ser Cys Gly Tyr Glu Glu Lys Thr Glu Trp Gly Lys Glu Ile Gly		
755	760	765
Trp Ile Tyr Gly Ser Val Thr Glu Asp Ile Leu Thr Gly Phe Lys Met		
770	775	780
His Cys Arg Gly Trp Lys Ser Val Tyr Cys Thr Pro Thr Arg Pro Ala		
785	790	795
Phe Lys Gly Ser Ala Pro Ile Asn Leu Ser Asp Arg Leu His Gln Val		
805	810	815
Leu Arg Trp Ala Leu Gly Ser Val Glu Ile Phe Met Ser Arg His Cys		
820	825	830
Pro Leu Arg Tyr Ala Tyr Gly Gly Arg Leu Lys Trp Leu Glu Arg Phe		
835	840	845
Ala Tyr Thr Asn Thr Ile Val Tyr Pro Phe Thr Ser Ile Pro Leu Leu		
850	855	860
Ala Tyr Cys Thr Ile Pro Ala Val Cys Leu Leu Thr Gly Lys Phe Ile		
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Ile Pro Thr Leu Asn Asn Leu Ala Ser Ile Trp Phe Ile Ala Leu Phe		
885	890	895
Leu Ser Ile Ile Ala Thr Ser Val Leu Glu Leu Arg Trp Ser Gly Val		
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Ser Ile Glu Asp Trp Trp Arg Asn Glu Gln Phe Trp Val Ile Gly Gly		
915	920	925
Val Ser Ala His Leu Phe Ala Val Phe Gln Gly Phe Leu Lys Val Leu		
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Gly Gly Val Asp Thr Ser Phe Thr Val Thr Ser Lys Ala Ala Gly Asp		
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Glu Ala Asp Ala Phe Gly Asp Leu Tyr Leu Phe Lys Trp Thr Thr Leu		

965	970	975
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Ala Gly Val Ser Asp Ala Val Asn Asn Gly Tyr Gly Ser Trp Gly Pro		
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Leu Phe Gly Lys Leu Phe Phe Ser Phe Trp Val Ile Val His Leu Tyr		
1010	1015	1020
Pro Phe Leu Lys Gly Leu Met Gly Arg Gln Asn Arg Thr Pro Thr Ile		
1025	1030	1035
Val Val Leu Trp Ser Ile Leu Leu Ala Ser Ile Phe Ser Leu Val Trp		
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<211> 3231

<212> DNA

<213> Zea mays

<400> 27

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<211> 1007

<212> PRT

<213> Zea mays

<400> 28

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Gly	Asp	Tyr	Ala	Ala	Ile	Asn	Pro	Ala	Arg	Ala	Ser	Glu	Gly	Thr	Glu
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Glu	Arg	Val	Thr	Met	Gly	Ser	His	Leu	Asn	Asp	Arg	Gln	Asp	Glu	Val
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Ser	His	Ala	Arg	Thr	Met	Ser	Ser	Leu	Ser	Gly	Ile	Gly	Ser	Glu	Leu
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Asn	Asp	Glu	Ser	Gly	Lys	Pro	Ile	Trp	Lys	Asn	Arg	Val	Glu	Ser	Trp
							115					120			125
Lys	Glu	Lys	Lys	Asn	Glu	Lys	Ala	Ser	Ala	Lys	Lys	Thr	Ala	Ala	
							130					135			140
Lys	Ala	Gln	Pro	Pro	Pro	Val	Glu	Glu	Ile	Met	Asp	Glu	Lys	Asp	
							145					150			160
Leu	Thr	Asp	Ala	Tyr	Glu	Pro	Leu	Ser	Arg	Val	Ile	Pro	Ile	Ser	Lys
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Asn	Lys	Leu	Thr	Pro	Tyr	Arg	Ala	Val	Ile	Ile	Met	Arg	Leu	Ile	Val
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Leu	Gly	Leu	Phe	Phe	His	Tyr	Arg	Ile	Thr	Asn	Pro	Val	Asn	Ser	Ala
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Phe	Gly	Leu	Trp	Met	Thr	Ser	Val	Ile	Cys	Glu	Ile	Trp	Phe	Gly	Phe
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Thr	Tyr	Val	Asp	Arg	Leu	Ile	Ala	Arg	Tyr	Gly	Asp	Gly	Glu	Glu	Ser
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 Glu Pro Pro Leu Ile Thr Ala Asn Thr Val Leu Ser Ile Leu Ala Val
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 Ala Met Leu Thr Phe Glu Ser Leu Ala Glu Thr Ala Glu Tyr Ala Arg
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 Tyr Lys Val Arg Ile Asn Ala Leu Val Ala Lys Ala Gln Lys Thr Pro
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 Asp Glu Gly Trp Ile Met Gln Asp Gly Thr Pro Trp Pro Gly Asn Asn
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 Pro Arg Asp His Pro Gly Met Ile Gln Val Phe Leu Gly Glu Thr Gly
 405 410 415
 Ala Arg Asp Phe Asp Gly Asn Glu Leu Pro Arg Leu Val Tyr Val Ser
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 Arg Glu Lys Arg Pro Gly Tyr Glu His His Lys Lys Ala Gly Ala Met
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 Tyr Val Gln Phe Pro Gln Arg Phe Asp Gly Ile Asp Arg Ser Asp Arg
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 Tyr Ala Asn Arg Asn Val Val Phe Phe Asp Val Asn Met Lys Gly Leu
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 Asp Gly Leu Gln Gly Pro Val Tyr Val Gly Thr Gly Cys Cys Phe Asn
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 Lys Ser Ser Ile Cys Ser Trp Cys Cys Cys Cys Pro Lys Lys Lys
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 Val Pro Glu Ser Ala Asn Pro Ser Thr Leu Ile Lys Glu Ala Ile His
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 Val Ile Ser Cys Gly Tyr Glu Glu Lys Thr Glu Trp Gly Lys Glu Ile
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 Met His Cys Arg Gly Trp Arg Ser Ile Tyr Cys Met Pro Val Arg Pro
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Cys	Pro	Leu	Trp	Tyr	Gly	Tyr	Gly	Gly	Arg	Leu	Lys	Trp	Leu	Gln	
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Leu	Ile	Pro	Pro	Thr	Ser	Ile	Leu	Val	Leu	Asn	Leu	Val	Gly	Val	Val
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Val	Lys	Ile	Asp	Pro	Phe	Val	Gly	Gly	Thr	Glu	Thr	Val	Asn	Thr	Asn
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<211> 1052

<212> PRT

<213> Zea mays

<400> 30

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Ser Gly Gln Val Cys Glu Ile Cys Gly Asp Glu Val Gly Leu Thr Val

35 40 45

Asp Gly Asp Leu Phe Val Ala Cys Asn Glu Cys Gly Phe Pro Val Cys

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Gln Cys Lys Thr Arg Tyr Lys Arg Leu Lys Gly Ser Pro Arg Val Ala		80
85	90	95
Gly Asp Asp Asp Glu Glu Asp Ile Asp Asp Leu Glu His Glu Phe Asn		
100	105	110
Ile Asp Asp Glu Asn Gln Gln Arg Gln Leu Glu Gly Asn Met Gln Asn		
115	120	125
Ser Gln Ile Thr Glu Ala Met Leu His Gly Arg Met Ser Tyr Gly Arg		
130	135	140
Gly Pro Asp Asp Gly Asp Gly Asn Asn Thr Pro Gln Ile Pro Pro Ile		
145	150	155
Ile Thr Gly Ser Arg Ser Val Pro Val Ser Gly Glu Phe Pro Ile Thr		160
165	170	175
Asn Gly Tyr Gly His Gly Glu Val Ser Ser Ser Leu His Lys Arg Ile		
180	185	190
His Pro Tyr Pro Val Ser Glu Pro Gly Ser Ala Lys Trp Asp Glu Lys		
195	200	205
Lys Glu Val Ser Trp Lys Glu Arg Met Asp Asp Trp Lys Ser Lys Gln		
210	215	220
Gly Ile Leu Gly Gly Ala Asp Pro Glu Asp Met Asp Ala Asp Val		
225	230	235
Ala Leu Asn Asp Glu Ala Arg Gln Pro Leu Ser Arg Lys Val Ser Ile		240
245	250	255
Ala Ser Ser Lys Val Asn Pro Tyr Arg Met Val Ile Val Val Arg Leu		
260	265	270
Val Val Leu Ala Phe Phe Leu Arg Tyr Arg Ile Leu His Pro Val Pro		
275	280	285
Asp Ala Ile Gly Leu Trp Leu Val Ser Ile Ile Cys Glu Ile Trp Phe		
290	295	300
Ala Ile Ser Trp Ile Leu Asp Gln Phe Pro Lys Trp Phe Pro Ile Asp		
305	310	315
Arg Glu Thr Tyr Leu Asp Arg Leu Ser Leu Arg Tyr Glu Arg Glu Gly		320
325	330	335
Glu Pro Ser Leu Leu Ser Ala Val Asp Leu Phe Val Ser Thr Val Asp		
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Pro Leu Lys Glu Pro Pro Leu Val Thr Ala Asn Thr Val Leu Ser Ile		
355	360	365
Leu Ala Val Asp Tyr Pro Val Asp Lys Val Ser Cys Tyr Val Ser Asp		
370	375	380
Asp Gly Ala Ser Met Leu Thr Phe Glu Ser Leu Ser Glu Thr Ala Glu		
385	390	395
Phe Ala Arg Lys Trp Val Pro Phe Cys Lys Lys Phe Gly Ile Glu Pro		400
405	410	415
Arg Ala Pro Glu Phe Tyr Phe Ser Leu Lys Val Asp Tyr Leu Lys Asp		
420	425	430
Lys Val Gln Pro Thr Phe Val Gln Glu Arg Arg Ala Met Lys Arg Glu		
435	440	445
Tyr Glu Glu Phe Lys Val Arg Ile Asn Ala Leu Val Ala Lys Ala Met		
450	455	460
Lys Val Pro Ala Glu Gly Trp Ile Met Lys Asp Gly Thr Pro Trp Pro		
465	470	475
Gly Asn Asn Thr Arg Asp His Pro Gly Met Ile Gln Val Phe Leu Gly		480
485	490	495
His Ser Gly Gly His Asp Thr Glu Gly Asn Glu Leu Pro Arg Leu Val		
500	505	510
Tyr Val Ser Arg Glu Lys Arg Pro Gly Phe Gln His His Lys Lys Ala		

515	520	525
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Pro Phe Met Leu Asn Leu Asp Cys Asp His Tyr Ile Asn Asn Ser Lys		
545	550	555
Ala Ile Arg Glu Ala Met Cys Phe Leu Met Asp Pro Gln Val Gly Arg		560
565	570	575
Lys Val Cys Tyr Val Gln Phe Pro Gln Arg Phe Asp Gly Ile Asp Val		
580	585	590
His Asp Arg Tyr Ala Asn Arg Asn Thr Val Phe Phe Asp Ile Asn Met		
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Lys Gly Leu Asp Gly Ile Gln Gly Pro Val Tyr Val Gly Thr Gly Cys		
610	615	620
Val Phe Arg Arg Gln Ala Leu Tyr Gly Tyr Asn Pro Pro Lys Gly Pro		
625	630	635
Lys Arg Pro Lys Met Val Thr Cys Asp Cys Cys Pro Cys Phe Gly Arg		640
645	650	655
Lys Lys Arg Lys His Ala Lys Asp Gly Leu Pro Glu Gly Thr Ala Asp		
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Met Gly Val Asp Ser Asp Lys Glu Met Leu Met Ser His Met Asn Phe		
675	680	685
Glu Lys Arg Phe Gly Gln Ser Ala Ala Phe Val Thr Ser Thr Leu Met		
690	695	700
Glu Glu Gly Gly Val Pro Pro Ser Ser Pro Ala Ala Leu Leu Lys		
705	710	715
Glu Ala Ile His Val Ile Ser Cys Gly Tyr Glu Asp Lys Thr Asp Trp		720
725	730	735
Gly Leu Glu Leu Gly Trp Ile Tyr Gly Ser Ile Thr Glu Asp Ile Leu		
740	745	750
Thr Gly Phe Lys Met His Cys Arg Gly Trp Arg Ser Val Tyr Cys Met		
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770	775	780
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Phe Ser Arg His Ser Pro Leu Leu Tyr Gly Tyr Lys Asn Gly Asn Leu		800
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Thr Ser Leu Pro Leu Leu Ala Tyr Cys Thr Leu Pro Ala Val Cys Leu		
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Leu Thr Gly Lys Phe Ile Met Pro Ser Ile Ser Thr Phe Ala Ser Leu		
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Met Arg Trp Ser Gly Val Ser Ile Glu Glu Trp Trp Arg Asn Glu Gln		880
885	890	895
Phe Trp Val Ile Gly Gly Val Ser Ala His Leu Phe Ala Val Val Gln		
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Gly Leu Leu Lys Val Leu Ala Gly Ile Asp Thr Asn Phe Thr Val Thr		
915	920	925
Ser Lys Ala Thr Gly Asp Glu Asp Asp Glu Phe Ala Glu Leu Tyr Ala		
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Phe Lys Trp Thr Thr Leu Leu Ile Pro Pro Thr Thr Leu Leu Ile Ile		
945	950	955
Asn Val Ile Gly Val Val Ala Gly Ile Ser Asp Ala Ile Asn Asn Gly		960
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Tyr Gln Ser Trp Gly Pro Leu Phe Gly Lys Leu Phe Phe Ala Phe Trp		

980	985	990
Val Ile Val His Leu Tyr Pro Phe Leu Lys Gly Leu Met Gly Arg Gln		
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Asn Arg Thr Pro Thr Val Val Ile Trp Ser Ile Leu Leu Ala Ser		
1010	1015	1020
Ile Phe Ser Leu Leu Trp Val Arg Ile Asp Pro Phe Ile Val Arg Thr		
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Gln Asn Cys Pro Gln Cys Lys Thr Arg Phe Lys Arg Phe Lys Gly Cys
50 55 60
Ala Arg Val Pro Gly Asp Glu Glu Asp Gly Val Asp Asp Leu Glu
65 70 75 80
Asn Glu Phe Asn Trp Ser Asp Lys His Asp Ser Gln Tyr Leu Ala Glu
85 90 95
Ser Met Leu His Ala His Met Ser Tyr Gly Arg Gly Ala Asp Leu Asp
100 105 110
Gly Val Pro Gln Pro Phe His Pro Ile Pro Asn Val Pro Leu Leu Thr
115 120 125
Asn Gln Met Val Asp Asp Ile Pro Pro Asp Gln His Ala Leu Val
130 135 140
Pro Ser Phe Val Gly Gly Gly Lys Arg Ile His Pro Leu Pro Tyr
145 150 155 160
Ala Asp Pro Asn Leu Pro Val Gln Pro Arg Ser Met Asp Pro Ser Lys
165 170 175
Asp Leu Ala Ala Tyr Gly Tyr Gly Ser Val Ala Trp Lys Glu Arg Met
180 185 190
Glu Ser Trp Lys Gln Lys Gln Glu Arg Met His Gln Thr Arg Asn Asp
195 200 205
Gly Gly Gly Asp Asp Gly Asp Asp Ala Asp Leu Pro Leu Met Asp Glu
210 215 220
Ala Arg Gln Pro Leu Ser Arg Lys Ile Pro Leu Pro Ser Ser Gln Ile
225 230 235 240
Asn Pro Tyr Arg Met Ile Ile Ile Ile Arg Leu Val Val Leu Cys Phe
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Phe Phe His Tyr Arg Val Met His Pro Val Pro Asp Ala Phe Ala Leu
260 265 270
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305 310 315 320
Ala Pro Val Asp Phe Phe Val Ser Thr Val Asp Pro Leu Lys Glu Pro
325 330 335
Pro Leu Val Thr Ala Asn Thr Val Leu Ser Ile Leu Ser Val Asp Tyr
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Pro Val Asp Lys Val Ser Cys Tyr Val Ser Asp Asp Gly Ala Ala Met
355 360 365
Leu Thr Phe Glu Ala Leu Ser Glu Thr Ser Glu Phe Ala Lys Lys Trp
370 375 380
Val Pro Phe Cys Lys Arg Tyr Ser Leu Glu Pro Arg Ala Pro Glu Trp
385 390 395 400
Tyr Phe Gln Gln Lys Ile Asp Tyr Leu Lys Asp Lys Val Ala Pro Asn

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Leu Asp Cys Asp His Tyr Ile Asn Asn Ser Lys Ala Ile Lys Glu Ala			
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Gln Phe Pro Gln Arg Phe Asp Gly Ile Asp Arg His Asp Arg Tyr Ala			
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Ala Leu Tyr Gly Tyr Asp Ala Pro Lys Thr Lys Pro Pro Ser Arg			
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Cys Gly Tyr Glu Asp Lys Thr Gly Trp Gly Lys Asp Ile Gly Trp Ile			
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785	790	795	800
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Ile Asn Ser Ile Val Tyr Pro Trp Thr Ser Ile Pro Leu Leu Ala Tyr			
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Cys Thr Leu Pro Ala Ile Cys Leu Leu Thr Gly Lys Phe Ile Thr Pro			
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Gly Leu Val Gly Arg Gln Asn Arg Thr Pro Thr Ile Val Ile Val Trp			
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Ser Ile Leu Leu Ala Ser Ile Phe Ser Leu Leu Trp Val Arg Ile Asp			
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<211> 1074

<212> PRT

<213> Zea mays

<400> 46

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His His Arg Ile Pro Arg Leu Thr Ser Gly Gln Gln Ile Ser Gly Glu
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Ile Pro Asp Ala Ser Pro Asp Arg His Ser Ile Arg Ser Pro Thr Ser
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Ser Tyr Val Asp Pro Ser Val Pro Val Pro Val Arg Ile Val Asp Pro
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Ser Lys Asp Leu Asn Ser Tyr Gly Leu Asn Ser Val Asp Trp Lys Glu
195 200 205
Arg Val Glu Ser Trp Arg Val Lys Gln Asp Lys Asn Met Leu Gln Val
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Thr Asn Lys Tyr Pro Glu Ala Arg Gly Asp Met Glu Gly Thr Gly Ser
225 230 235 240
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245 250 255
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260 265 270
Ile Ile Leu Arg Leu Ile Ile Leu Cys Phe Phe Phe Gln Tyr Arg Ile
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290 295 300
Cys Glu Val Trp Phe Ala Leu Ser Trp Leu Leu Asp Gln Phe Pro Lys
305 310 315 320
Trp Tyr Pro Ile Asn Arg Glu Thr Tyr Leu Asp Arg Leu Ala Leu Arg
325 330 335
Tyr Asp Arg Glu Gly Glu Pro Ser Gln Leu Ala Pro Ile Asp Val Phe
340 345 350
Val Ser Thr Val Asp Pro Leu Lys Glu Pro Pro Leu Ile Thr Ala Asn
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370 375 380
Cys Tyr Val Ser Asp Asp Gly Ser Ala Met Leu Thr Phe Glu Ser Leu

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465	470	475	480
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Gln Val Phe Leu Gly His Ser Gly Gly Leu Asp Thr Asp Gly Asn Glu			
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Leu Pro Arg Leu Val Tyr Val Ser Arg Glu Lys Arg Pro Gly Phe Gln			
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His His Lys Lys Ala Gly Ala Met Asn Ala Leu Ile Arg Val Ser Ala			
530	535	540	
Val Leu Thr Asn Gly Ala Tyr Leu Leu Asn Val Asp Cys Asp His Tyr			
545	550	555	560
Phe Asn Ser Ser Lys Ala Leu Arg Glu Ala Met Cys Phe Met Met Asp			
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Pro Ala Leu Gly Arg Lys Thr Cys Tyr Val Gln Phe Pro Gln Arg Phe			
580	585	590	
Asp Gly Ile Asp Leu His Asp Arg Tyr Ala Asn Arg Asn Ile Val Phe			
595	600	605	
Phe Asp Ile Asn Met Lys Gly Leu Asp Gly Ile Gln Gly Pro Val Tyr			
610	615	620	
Val Gly Thr Gly Cys Cys Phe Asn Arg Gln Ala Leu Tyr Gly Tyr Asp			
625	630	635	640
Pro Val Leu Thr Glu Ala Asp Leu Glu Pro Asn Ile Val Val Lys Ser			
645	650	655	
Cys Cys Gly Arg Arg Lys Arg Lys Asn Lys Ser Tyr Met Asp Ser Gln			
660	665	670	
Ser Arg Ile Met Lys Arg Thr Glu Ser Ser Ala Pro Ile Phe Asn Met			
675	680	685	
Glu Asp Ile Glu Glu Gly Ile Glu Gly Tyr Glu Asp Glu Arg Ser Val			
690	695	700	
Leu Met Ser Gln Arg Lys Leu Glu Lys Arg Phe Gly Gln Ser Pro Ile			
705	710	715	720
Phe Ile Ala Ser Thr Phe Met Thr Gln Gly Gly Ile Pro Pro Ser Thr			
725	730	735	
Asn Pro Ala Ser Leu Leu Lys Glu Ala Ile His Val Ile Ser Cys Gly			
740	745	750	
Tyr Glu Asp Lys Thr Glu Trp Gly Lys Glu Ile Gly Trp Ile Tyr Gly			
755	760	765	
Ser Val Thr Glu Asp Ile Leu Thr Gly Phe Lys Met His Ala Arg Gly			
770	775	780	
Trp Gln Ser Ile Tyr Cys Met Pro Pro Arg Pro Cys Phe Lys Gly Ser			
785	790	795	800
Ala Pro Ile Asn Leu Ser Asp Arg Leu Asn Gln Val Leu Arg Trp Ala			
805	810	815	
Leu Gly Ser Val Glu Ile Leu Leu Ser Arg His Cys Pro Ile Trp Tyr			
820	825	830	
Gly Tyr Asn Gly Arg Leu Lys Leu Leu Glu Arg Leu Ala Tyr Ile Asn			
835	840	845	
Thr Ile Val Tyr Pro Ile Thr Ser Val Pro Leu Ile Ala Tyr Cys Val			

850	855	860
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865	870	875
Ser Asn Tyr Ala Gly Met Phe	Phe Ile Leu	Leu Phe Ala Ser Ile Phe
885	890	895
Ala Thr Gly Ile Leu Glu	Leu Arg Trp Ser Gly Val	Gly Ile Glu Asp
900	905	910
Trp Trp Arg Asn Glu Gln Phe	Trp Val Ile Gly Gly	Gly Thr Ser Ala His
915	920	925
Leu Phe Ala Val Phe Gln Gly	Leu Leu Lys Val	Leu Ala Gly Ile Asp
930	935	940
Thr Asn Phe Thr Val Thr Ser Lys	Ala Ser Asp Glu Asp Gly Asp Phe	
945	950	955
Ala Glu Leu Tyr Val Phe Lys	Trp Thr Ser Leu Leu Ile Pro Pro Thr	
965	970	975
Thr Val Leu Val Ile Asn Leu Val	Gly Met Val Ala Gly Ile Ser Tyr	
980	985	990
Ala Ile Asn Ser Gly Tyr Gln Ser	Trp Gly Pro Leu Phe Gly Lys Leu	
995	1000	1005
Phe Phe Ser Ile Trp Val Ile	Leu His Leu Tyr Pro Phe Leu Lys Gly	
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Leu Met Gly Arg Gln Asn Arg Thr Pro Thr	Ile Val Ile Val Trp Ser	
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Ile Leu Leu Ala Ser Ile Phe Ser	Leu Leu Trp Val Lys Ile Asp Pro	
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 35 40 45
 Ala Pro Gly Gly Asp Pro Phe Val Ala Cys Asn Glu Cys Ala Phe Pro
 50 55 60
 Val Cys Arg Asp Cys Tyr Glu Tyr Glu Arg Arg Glu Gly Thr Gln Asn
 65 70 75 80
 Cys Pro Gln Cys Lys Thr Arg Tyr Lys Arg Leu Lys Gly Cys Gln Arg
 85 90 95
 Val Thr Gly Asp Glu Glu Asp Gly Val Asp Asp Leu Asp Asn Glu
 100 105 110
 Phe Asn Trp Asp Gly His Asp Ser Gln Ser Val Ala Glu Ser Met Leu
 115 120 125
 Tyr Gly His Met Ser Tyr Gly Arg Gly Asp Pro Asn Gly Ala Pro
 130 135 140
 Gln Ala Phe Gln Leu Asn Pro Asn Val Pro Leu Leu Thr Asn Gly Gln
 145 150 155 160
 Met Val Asp Asp Ile Pro Pro Glu Gln His Ala Leu Val Pro Ser Phe
 165 170 175
 Met Gly Gly Gly Lys Arg Ile His Pro Leu Pro Tyr Ala Asp Pro
 180 185 190
 Ser Leu Pro Val Gln Pro Arg Ser Met Asp Pro Ser Lys Asp Leu Ala
 195 200 205
 Ala Tyr Gly Tyr Gly Ser Val Ala Trp Lys Glu Arg Met Glu Asn Trp
 210 215 220
 Lys Gln Arg Gln Glu Arg Met His Gln Thr Gly Asn Asp Gly Gly Gly
 225 230 235 240
 Asp Asp Gly Asp Asp Ala Asp Leu Pro Leu Met Asp Glu Ala Arg Gln
 245 250 255
 Gln Leu Ser Arg Lys Ile Pro Leu Pro Ser Ser Gln Ile Asn Pro Tyr
 260 265 270
 Arg Met Ile Ile Ile Ile Arg Leu Val Val Leu Gly Phe Phe Phe His
 275 280 285
 Tyr Arg Val Met His Pro Val Asn Asp Ala Phe Ala Leu Trp Leu Ile
 290 295 300
 Ser Val Ile Cys Glu Ile Trp Phe Ala Met Ser Trp Ile Leu Asp Gln
 305 310 315 320
 Phe Pro Lys Trp Phe Pro Ile Glu Arg Glu Thr Tyr Leu Asp Arg Leu

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Ser Leu Arg Phe Asp Lys Glu Gly Gln Pro Ser Gln Leu Ala Pro Ile		
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Asp Phe Phe Val Ser Thr Val Asp Pro Leu Lys Glu Pro Pro Leu Val		
355	360	365
Thr Thr Asn Thr Val Leu Ser Ile Leu Ser Val Asp Tyr Pro Val Asp		
370	375	380
Lys Val Ser Cys Tyr Val Ser Asp Asp Gly Ala Ala Met Leu Thr Phe		
385	390	395
Glu Ala Leu Ser Glu Thr Ser Glu Phe Ala Lys Lys Trp Val Pro Phe		
405	410	415
Cys Lys Arg Tyr Asn Ile Glu Pro Arg Ala Pro Glu Trp Tyr Phe Gln		
420	425	430
Gln Lys Ile Asp Tyr Leu Lys Asp Lys Val Ala Ala Asn Phe Val Arg		
435	440	445
Glu Arg Arg Ala Met Lys Arg Glu Tyr Glu Glu Phe Lys Val Arg Ile		
450	455	460
Asn Ala Leu Val Ala Lys Ala Gln Lys Val Pro Glu Glu Gly Trp Thr		
465	470	475
Met Gln Asp Gly Thr Pro Trp Pro Gly Asn Asn Val Arg Asp His Pro		
485	490	495
Gly Met Ile Gln Val Phe Leu Gly Gln Ser Gly Gly Leu Asp Cys Glu		
500	505	510
Gly Asn Glu Leu Pro Arg Leu Val Tyr Val Ser Arg Glu Lys Arg Pro		
515	520	525
Gly Tyr Asn His His Lys Lys Ala Gly Ala Met Asn Ala Leu Val Arg		
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Val Ser Ala Val Leu Thr Asn Ala Pro Tyr Leu Leu Asn Leu Asp Cys		
545	550	555
Asp His Tyr Ile Asn Asn Ser Lys Ala Ile Lys Glu Ala Met Cys Phe		
565	570	575
Met Met Asp Pro Leu Leu Gly Lys Lys Val Cys Tyr Val Gln Phe Pro		
580	585	590
Gln Arg Phe Asp Gly Ile Asp Arg His Asp Arg Tyr Ala Asn Arg Asn		
595	600	605
Val Val Phe Phe Asp Ile Asn Met Lys Gly Leu Asp Gly Ile Gln Gly		
610	615	620
Pro Ile Tyr Val Gly Thr Gly Cys Val Phe Arg Arg Gln Ala Leu Tyr		
625	630	635
Gly Tyr Asp Ala Pro Lys Thr Lys Lys Pro Pro Ser Arg Thr Cys Asn		
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Cys Trp Pro Lys Trp Cys Phe Cys Cys Cys Phe Gly Asn Arg Lys		
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Gln Lys Lys Thr Thr Lys Pro Lys Thr Glu Lys Lys Lys Leu Leu Phe		
675	680	685
Phe Lys Lys Glu Glu Asn Gln Ser Pro Ala Tyr Ala Leu Gly Glu Ile		
690	695	700
Asp Glu Ala Ala Pro Gly Ala Glu Asn Glu Lys Ala Gly Ile Val Asn		
705	710	715
Gln Gln Lys Leu Glu Lys Lys Phe Gly Gln Ser Ser Val Phe Val Thr		
725	730	735
Ser Thr Leu Leu Glu Asn Gly Gly Thr Leu Lys Ser Ala Ser Pro Ala		
740	745	750
Ser Leu Leu Lys Glu Ala Ile His Val Ile Ser Cys Gly Tyr Glu Asp		
755	760	765
Lys Thr Asp Trp Gly Lys Glu Ile Gly Trp Ile Tyr Gly Ser Val Thr		
770	775	780
Glu Asp Ile Leu Thr Gly Phe Lys Met His Cys His Gly Trp Arg Ser		

785	790	795	800												
Ile	Tyr	Cys	Ile	Pro	Lys	Arg	Val	Ala	Phe	Lys	Gly	Ser	Ala	Pro	Leu
805	810	815													
Asn	Leu	Ser	Asp	Arg	Leu	His	Gln	Val	Leu	Arg	Trp	Ala	Leu	Gly	Ser
820	825	830													
Ile	Glu	Ile	Phe	Phe	Ser	Asn	His	Cys	Pro	Leu	Trp	Tyr	Gly	Tyr	Gly
835	840	845													
Gly	Gly	Leu	Lys	Phe	Leu	Glu	Arg	Phe	Ser	Tyr	Ile	Asn	Ser	Ile	Val
850	855	860													
Tyr	Pro	Trp	Thr	Ser	Ile	Pro	Leu	Leu	Ala	Tyr	Cys	Thr	Leu	Pro	Ala
865	870	875	880												
Ile	Cys	Leu	Leu	Thr	Gly	Lys	Phe	Ile	Thr	Pro	Glu	Leu	Asn	Asn	Val
885	890	895													
Ala	Ser	Leu	Trp	Phe	Met	Ser	Leu	Phe	Ile	Cys	Ile	Phe	Ala	Thr	Ser
900	905	910													
Ile	Leu	Glu	Met	Arg	Trp	Ser	Gly	Val	Gly	Ile	Asp	Asp	Trp	Trp	Arg
915	920	925													
Asn	Glu	Gln	Phe	Trp	Val	Ile	Gly	Gly	Val	Ser	Ser	His	Leu	Phe	Ala
930	935	940													
Val	Phe	Gln	Gly	Leu	Leu	Lys	Val	Ile	Ala	Gly	Val	Asp	Thr	Ser	Phe
945	950	955	960												
Thr	Val	Thr	Ser	Lys	Gly	Gly	Asp	Asp	Glu	Glu	Phe	Ser	Glu	Leu	Tyr
965	970	975													
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980	985	990													
Leu	Asn	Phe	Ile	Gly	Val	Val	Ala	Gly	Val	Ser	Asn	Ala	Ile	Asn	Asn
995	1000	1005													
Gly	Tyr	Glu	Ser	Trp	Gly	Pro	Leu	Phe	Gly	Lys	Leu	Phe	Phe	Ala	Phe
1010	1015	1020													
Trp	Val	Ile	Val	His	Leu	Tyr	Pro	Phe	Leu	Lys	Gly	Leu	Val	Gly	Arg
1025	1030	1035	1040												
Gln	Asn	Arg	Thr	Pro	Thr	Ile	Val	Ile	Val	Trp	Ser	Ile	Leu	Leu	Ala
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Ser	Ile	Phe	Ser	Leu	Leu	Trp	Val	Arg	Ile	Asp	Pro	Phe	Leu	Ala	Lys
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